THE WESTERN GAS CONSTRUCTION CO.

GAS ENGINEERS AND BUILDERS

SAN FRANCISCO FORT WAYNE, IND. NEW YORK

BULLETIN No. 210.

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"The Western" Water Gas Apparatus.

AWARDED

GRAND PRIZE

AND

GOLD MEDAL

AT

LOUISIANA PURCHASE EXHIBITION, AT ST. LOUIS, 1904.

BY INTERNATIONAL JURY, TO

THE WESTERN GAS CONSTRUCTION COMPANY,

FORT WAYNE, INDIANA.

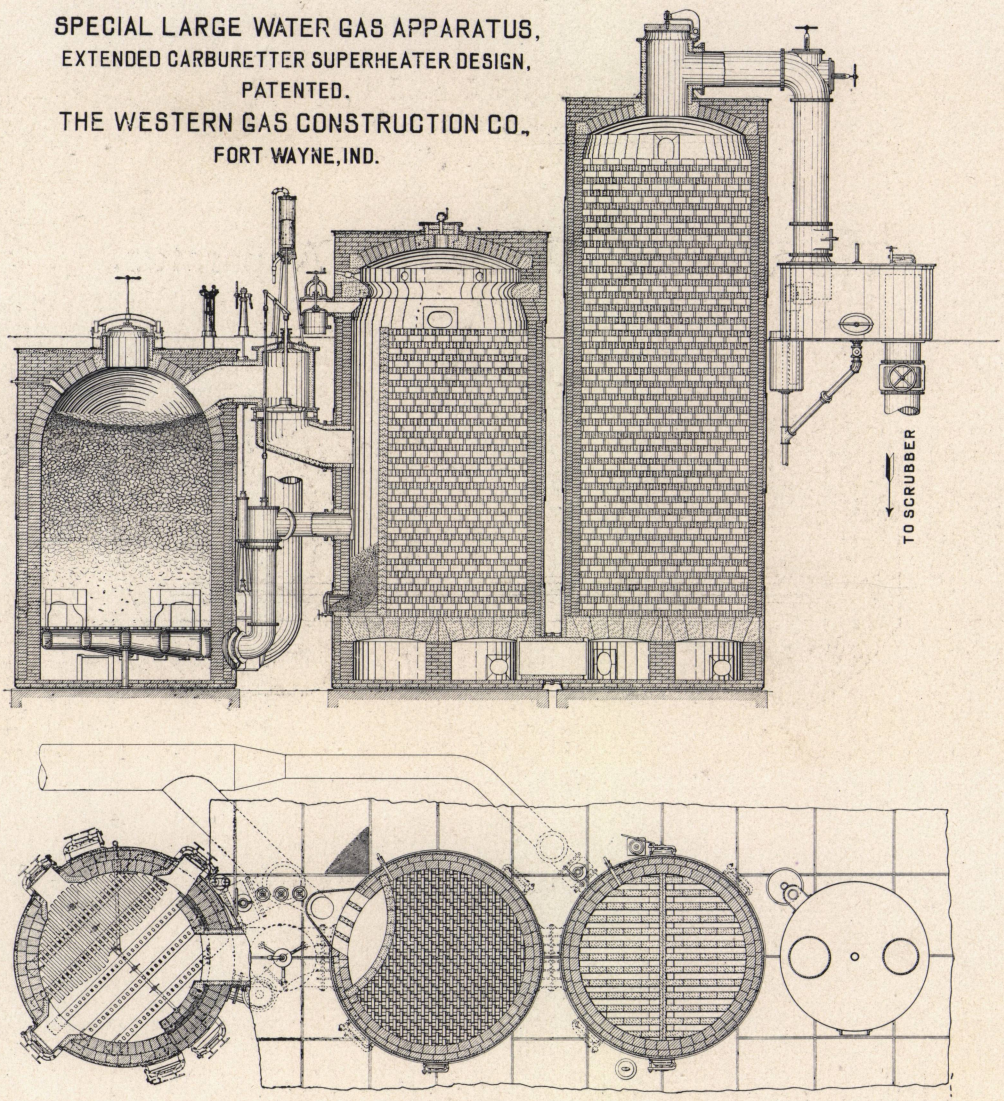

Fig. 1.

Plan and Elevation of the Latest Type of "The Western" 13'-0" Extended Carburetter Superheater Apparatus. Capacity, 3,000,000 cu. ft. per diem.

The drawings in this Bulletin are not produced to scale, being prepared for illustration only.

Development of "The Western" Carburetted Water Gas Apparatus.

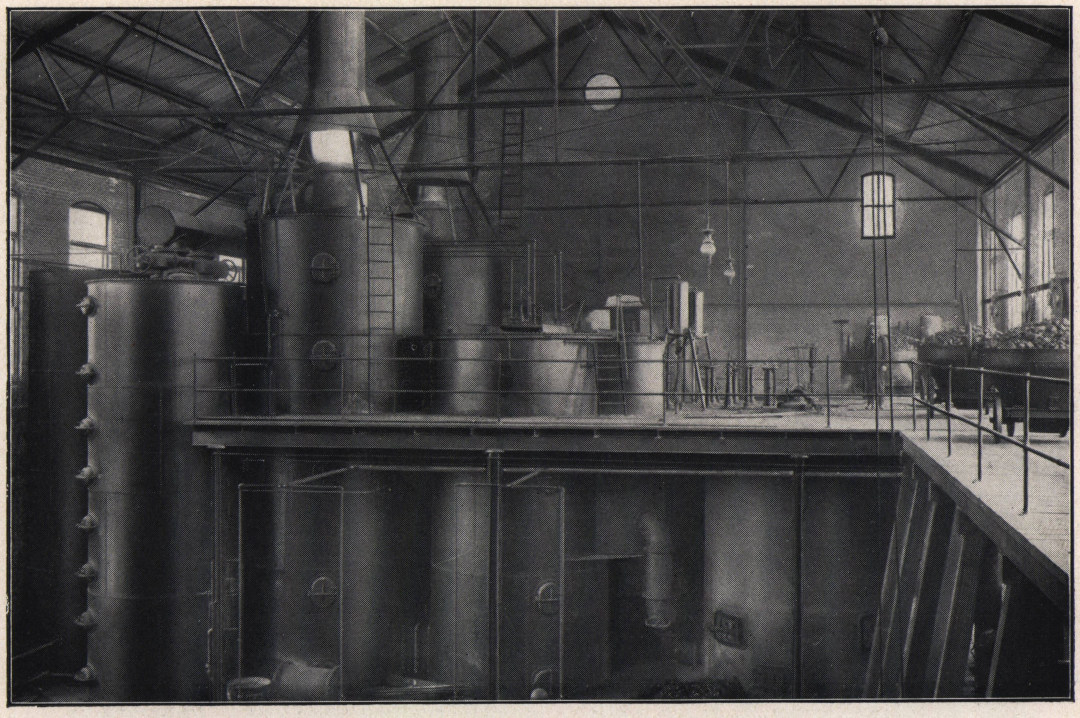

Fig. 2.
General View of Two 11′ sets Extended Carburetter Superheater Design.
For Operating Floor and Equipment see Page 15.

General.

Upon the patents of T. S. C. Lowe becoming public property in September 1892, this Company entered the field of Water Gas Construction.

Since that time this branch of our business has been given especial attention, and we have ever aimed toward improvement of design with utmost vigor in this as in other branches of our business. In consequence our design has been gradually developed until at present it has reached a high state of perfection and is operated in a number of the largest cities in the country. Cuts of the latest design of our water gas apparatus appear upon the opposite and this page, and of the development of this type as a whole, this bulletin will treat, leaving the details of construction to be considered in the subsequent supplements, 210 A.—B. etc.

Early Forms.

Prior to the expiration of the Lowe patents, the developing and improving of water gas apparatus was exceedingly slow, as the entire business was controlled by one Company; they were subject to very limited competition. In the original designs the operations of manufacturing carburetted water gas were carried on mostly within one or two shells,* but at present these forms are practically obsolete having given away to the one general type embracing generator, carburetter, superheater, hydraulic seal and the necessary scrubbing and condensing apparatus.

When competitors began putting water gas apparatus on the market, their designs were not very different from the ordinary; the reason being that buyers, many of whom were not at all familiar with the principles of water gas manufacture, were loath to accept the improved apparatus, and the demand was for some form whose merits were known. However, this Company succeeded in demonstrating the true worth of the improved features of its design, the buyers gained confidence, evidenced by the rapid increase in our business, and made a rapid development of apparatus possible with resultant increased efficiencies. We cite the following as substantiating this.

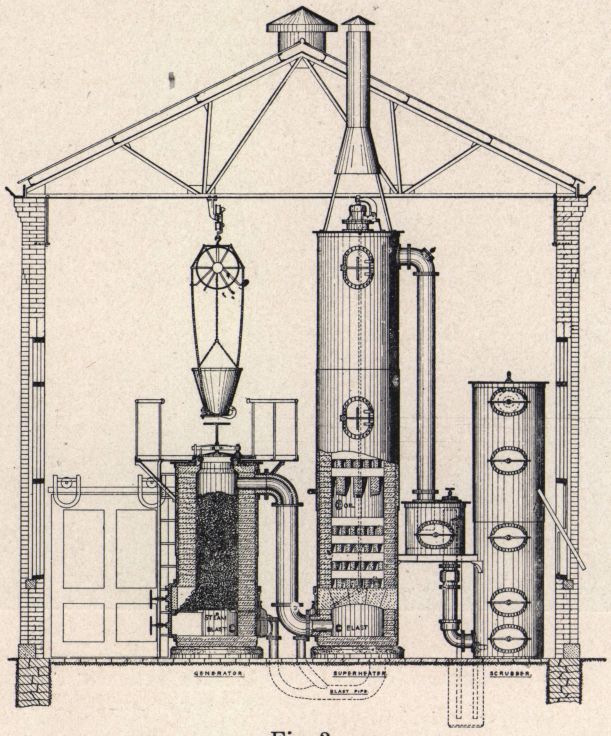

Fig. 3.
Single Superheater Setting for small Works.

Early Capacity Rating.

In 1892 the guaranteed capacity of an 8 feet 6 inch set, operating with coke, was 500,000 to 600,000 cubic feet of carburetted water gas per 24 hours, making 20 C. P. gas on 5 gallons of oil. With our present apparatus we easily fulfill a guarantee of over 1,000,000 cubic feet of gas per 24 hours with the same candle power, using less than 4 gallons of lower grade oil.

*For a description of the early forms of Water Gas Apparatus see the excellent paper by Mr. F. H. Shelton in Proceedings of American Gas Light Association of 1889.

The first forms we put on the market comprised different styles suited to varied manufacturing requirements. These are illustrated in Figures 3, 4, 5, and 6 and are classified as follows:

1. **Single Superheater Apparatus.** For capacity less than 125,000 cubic feet per diem.

2. **Combined Carburetter Superheater Apparatus.** Carburetter and superheater in one shell with separate blast to each division of chamber and carburetting oil introduced directly above lower division. Classification.

3. **Improved Double Superheater Apparatus.** Carburetter and Superheater in separate shells; this form subsequently developed into our

Extended Carburetter Superheater Apparatus.

Fig. 3. illustrates a single superheater apparatus, one of the first designs we put on the market. This is especially adapted for small works and presents a machine which in practical operation has demonstrated that the water gas process is a commercial success in the smallest works, having outputs even as low as 5,000 to 10,000 cubic feet per diem.

From these machines of small capacity termed our "Special" was developed our "Pony" design of Double Superheater Type, having charging platform on the generator and carburetter and provisions for the operation of the machine from the ground floor. See Bulletin 210A.

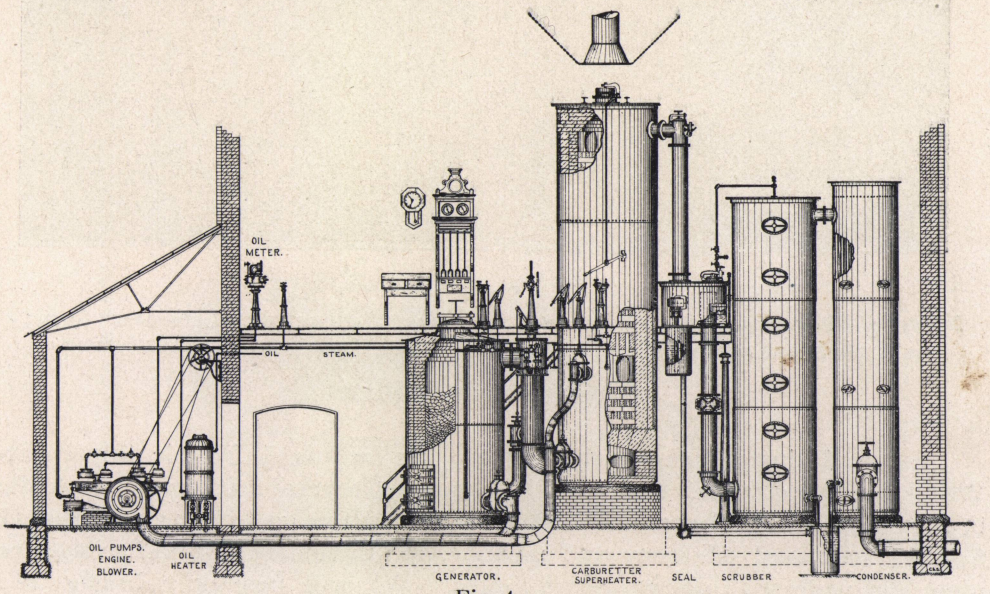

Fig. 4.
Combined Carburetter Superheater Setting.

Figure 4 is an illustration of our combined carburetter superheater type. This was originally designed to overcome objections to the Springer and similar apparatus and is especially adapted for works where space is limited.

Reconstruction Earlier Apparatus.

It allows for economical intermittent operation and small first cost. The Springer, Mackay–Critchlow, Granger, Peter English and similar forms of apparatus have been reconstructed by us to this type at moderate cost and with entirely satisfactory operating results, as well as increased capacity.

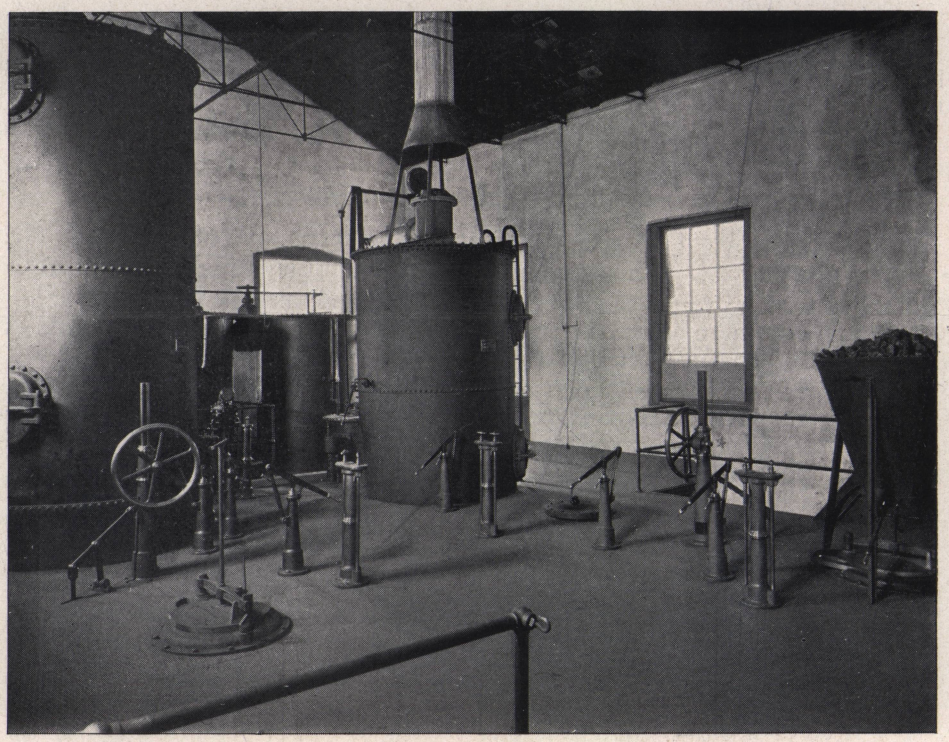

Fig. 5.
Operating Floor of two sets; left hand set "Combined Carburetter Superheater" Type; right hand—our regular "Low Carburetter" Type of Double Superheater Setting.

Low Carburetter Apparatus.

Figure 6 illustrates an early form of our improved Double Superheater Water Gas Apparatus. In it were incorporated several features not embodied in the machines of other concerns. These features proved their value from the first by increased efficiency and capacity, and have been gradually improved upon and perfected to our present forms. We will here only briefly dwell upon these features, leaving the details of construction to be described in supplements to this bulletin.

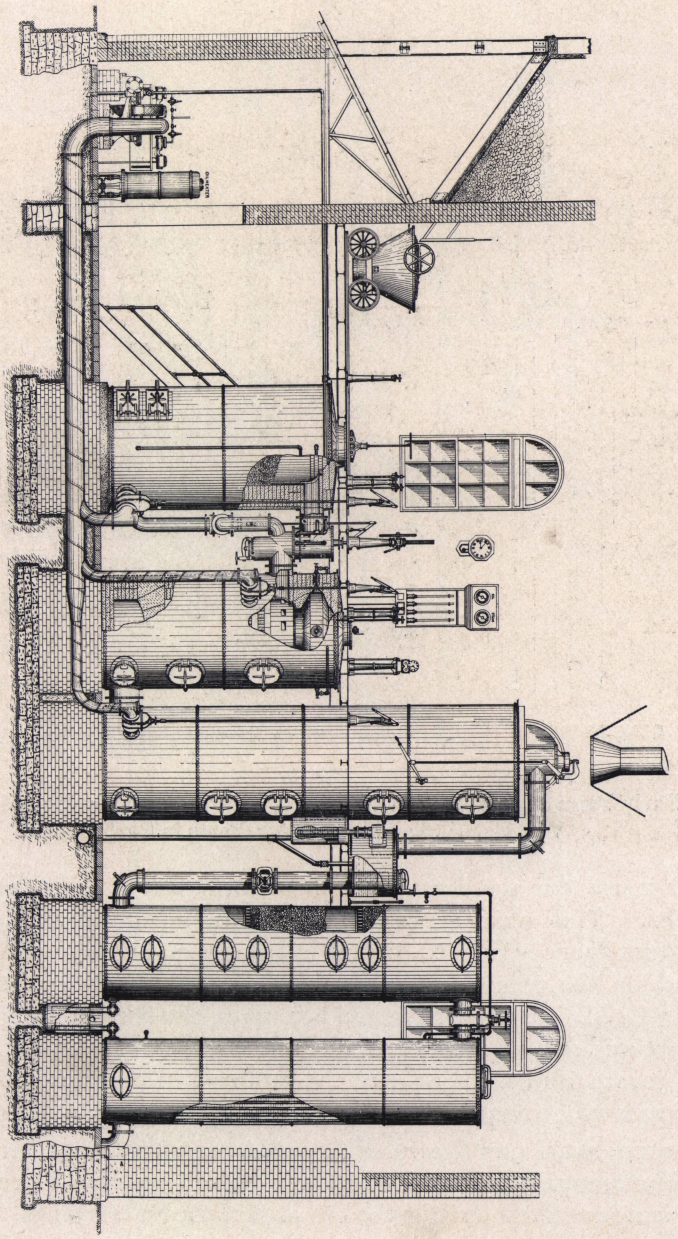

Fig. 6.
One of the first forms of our Improved Double Superheater Lowe Water Gas Apparatus.

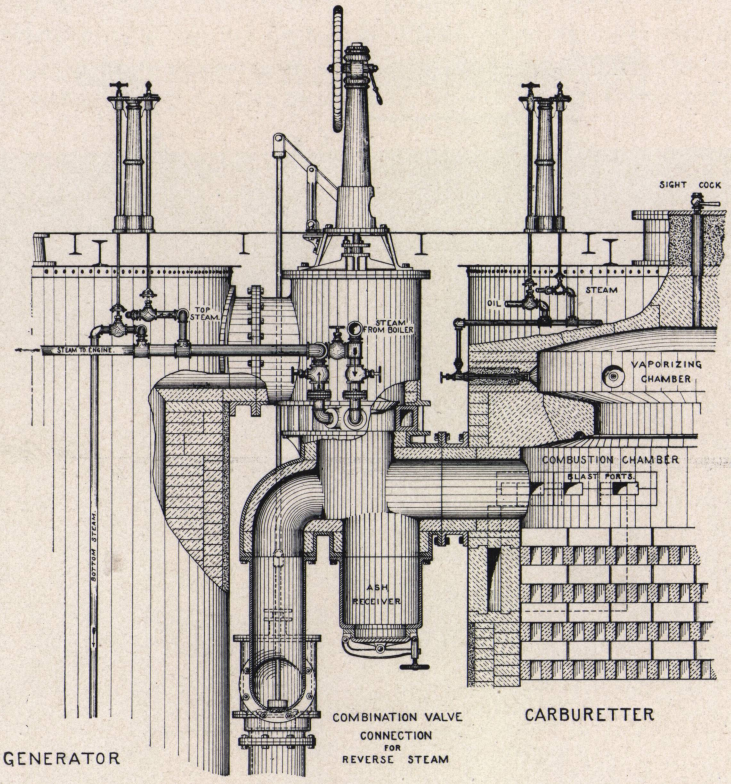

Fig. 7.
Early Form of Combination Valve and Connection showing Ash Pocket, Vaporizing Chamber and Air Ports in Carburetter.

Deep Fuel Bed.

In our generator we discarded the cone bottom ash dump common in other types. This only served as additional surface for condensation of the steam; and its space is put to better advantage in increasing the depth of fuel bed, which idea originated with this Company. Without it also the shell is completely lined. It may be noted here that the shells of all our generators, carburetters and superheaters are now lined *doubly* in such a manner as to break all joints and to permit of the removal of the inner course of brick for repairs or renewal, except the carburetter and superheater of the smaller sizes.

Reversed Steam.

We incorporated our *Reversed Steam Arrangement* in our early forms of apparatus fully recognizing the advantages gained by the "down run." Its value had been demonstrated during the life of the Lowe patents, but mechanical difficulties and price prevented its use. Our competition later forced its general adoption. In connection with this arrangement we introduced our Combination Ball Valve with its hollow seat through which all the steam to the gen-

Ball Valve.

erator may pass. The valve seat is thereby cooled and the steam dried and superheated. The unexpected difficulties experienced earlier in producing steel castings suitable for this purpose have now been entirely overcome by a special steel and method of making same. Figs. 6, 7, 17 and 18 show various types of this reversed steam arrangement which we have developed for our machines.

Below the ball valve was placed the *Ash Receiver* into which the cinders and ashes from the generator blast fell. Without this these cinders and ashes were deposited upon the upper layers of checker brick of the carburetter, necessitating frequent cleaning and renewal. Different forms of the receiver are illustrated in cuts of the Reversed Steam Arrangement. The ash receiver in our latest apparatus is at the bottom of the *Up-take Flue* placed within the carburetter shell as shown in Figs. 1, 17 and 18. (Patent 790,296.)

Ash Receiver.

Up-take Flue.

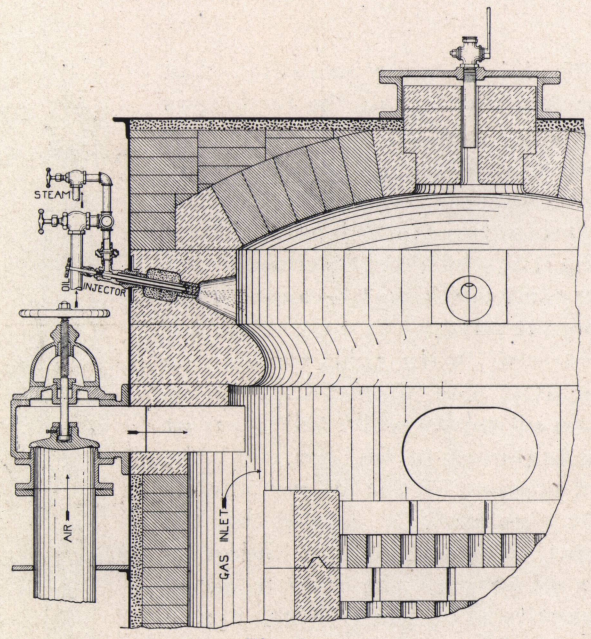

Fig. 8.
Present form of Vaporizing Chamber showing also position of the Oil Injector recessed into lining.

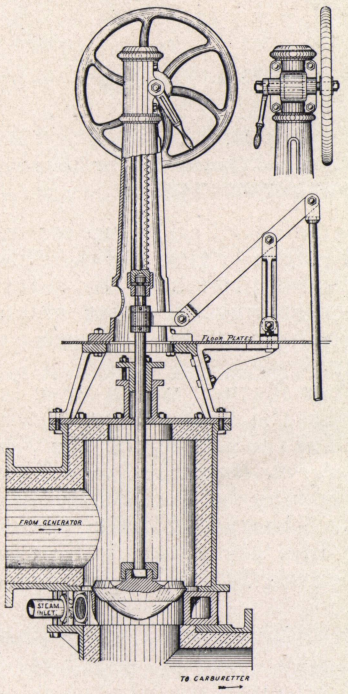

Fig. 9.
Early form of Ball Valve and Connection.

Another prominent and important feature of our early apparatus is the *Vaporizing Chamber.* This is above the checker brick chamber of carburetter and into it the oil is sprayed laterally from three or more spray injectors. The oil mist in passing downward from the vaporizing chamber, meets and is thoroughly mixed with the incoming blue water gas before reaching the heated checker brick. The quantity of hard carbon formed is thus very materially less than with machines where the oil is sprayed vertically downward upon the checker brick.

Vaporizing Chamber.

Recessed Oil Injectors

The injectors are protected from the direct action of the hot gases by being recessed in the lining as shown in Fig. 11 and further by the projecting tiles below them.

Automatic Oil Feed System.

Our automatic oil feed system (Fig. 12) which we introduced with our early machines was another important advance in water gas construction. With this system the operator has simply to turn the main oil supply valve full open at the beginning of the run, and the full pressure of the oil, automatically regulated, is carried to the point of spray. The oil injectors are set to pass the predetermined quantity of oil per minute, and a constant pressure in the oil supply is maintained by our automatically regulated pump, or our special design balanced pump. In closing the main supply oil valve at the end of the run, no further attention is required. All the oil is preheated in our Exhaust or Live Steam Oil Heater, which with the regulated or balanced oil pump is usually located in the engine room. The system is the simplest and the surest and the one requiring the least attention for absolutely uniformly preheated oil supply.

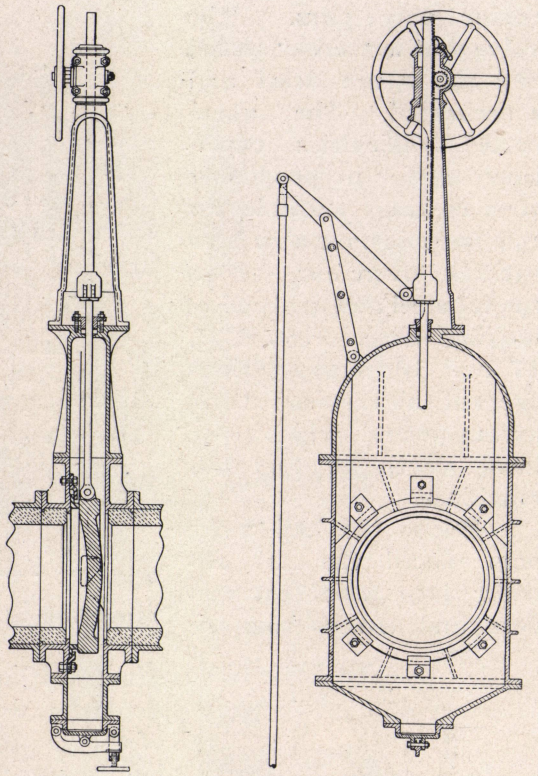

Fig. 10.
Detail of Gate Valve and Connection for Reversed Steam Arrangement.

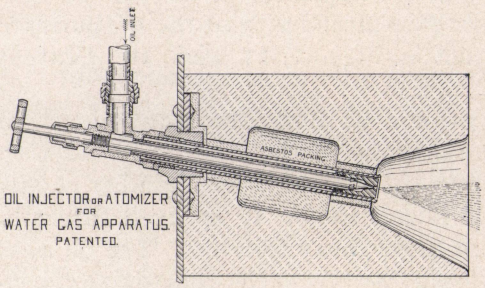

Fig. 11.
Latest Form of Oil Injector.

Still another feature which was introduced with the first forms of our apparatus was the placing of the *Seal upon the Level of the Operating Floor*. Thus the overflow may be constantly and conveniently observed by the operator, giving him the surest indication as to the heats. The overflow is also adjustable.

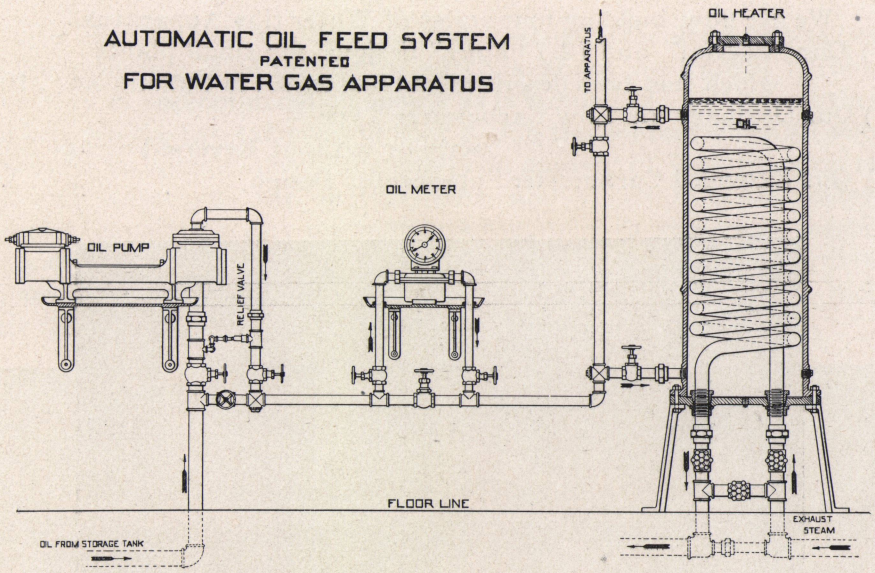

Fig. 12.

We own the exclusive rights to manufacture and install this Oil System, and all others are infringing.

Date of some of our patents covering the feature above referred to.

Patent No. 510506. REVERSED STEAM ARRANGEMENT VALVES, (1st Patent)
Filed May 9, 1892, *Granted Dec.* 12, 1893

Patent No. 524108. STEAM SUPPLY AND CIRCULATING SYSTEM,
Filed Nov. 21 1893, *Granted Aug.* 7, 1894. Patents.

Patent No. 528372. OIL FEED SYSTEM,
Filed Nov. 21, 1893, *Granted Nov.* 6, 1894.

Patent No. 529262. VAPORIZING CHAMBER,
Filed Aug. 14, 1894, *Granted Nov.* 13, 1894.

Patent No. 546011. OIL INJECTOR,
Filed Nov 9, 1893, *Granted Sepl.* 10, 1895.

Patent No. 567709. REVERSED STEAM VALVE, (2nd Patent,)
Filed Jan. 20, 1894, *Granted Sept.* 15, 1896.

Patent No. 644511. ASH CHAMBER AND SWIVEL JOINT FOR BALL VALVE,
Filed Feb, 23, 1897, *Granted Feb.* 27, 1900.

Reference to the patents below will be found on pages 15, 16 and 17.

Patent No. 721695. DEVICE FOR FEEDING AIR AND STEAM TO FURNACES,
Filed Feb. 8, 1902, *Granted March* 3, 1903.

Patent No. 790296. EXTENDED CARBURETTER SUPERHEATER APPARATUS,
Filed July 31, 1902, *Granted May* 23, 1905.

Patent Pending. INDEPENDENT STEAM DISTRIBUTION SYSTEM.

We own the exclusive rights to manufacture, sell and install apparatus embodying any of the features covered in any or all of the claims of the above patents. The manufacture, sale or installation by others—or the use of such are infringements.

Present Designs,

We are now building four styles of Water Gas Apparatus.
(1.) Our "Special" and (2.) "Pony" designs for small plants which has been described and illustrated in Bulletin No. 210—A.
(3.) Our Ordinary or Low Carburetter Type with or without Reversed Steam Supply.
(4.) Our Extended Carburetter Superheater Design.

Fig. 13.
General View of Low Carburetter Double Superheater Setting.

Double Superheater Type.

The last two types are built for medium and large sized works and are illustrated in this bulletin. Our ordinary or *Low Carburetter* design we now install only when first cost must be kept at lowest point forfeiting necessarily the highest capacity and efficiency as obtainable with our *Extended Carburetter Superheatur* type. However we guarantee our ordinary or low carburetter design as to capacity and efficiency to be fully equal to apparatus of the same size built by any other Company, operating expense and cost of maintenance and repairs lower than any other, except of course our Extended Carburetter Superheater type.

Low Carburetter.

Working Heats.

The principal difficulty with all water gas apparatus of the low carburetter type has been that with the high heat in the checker brick necessary for *maximum* capacity, there is *reduced efficiency* by the loss of illuminants resulting from the formation of the troublesome lampblack so often occuring in water gas manufacture. The lampblack can be done away with by operat-

ing with checker brick at low heat, but a second difficulty arises in this case with the formation of water gas tar which is about as fruitful of objection in the way of uneconomical oil results as is lampblack. Of course there is a mean between the two extremes of heat within the limits of which all water gas makers aim to operate, producing minimum amount of lampblack on the one hand, and water gas tar on the other, and which, of course, determines economical capacity of any machine. But even with the most careful and best operation the oils are liable to be cracked too far with the formation of comparatively large percentages of light hydrocarbons, such as methane, rather than the higher illuminating or heavy hydrocarbons.

Illuminants.

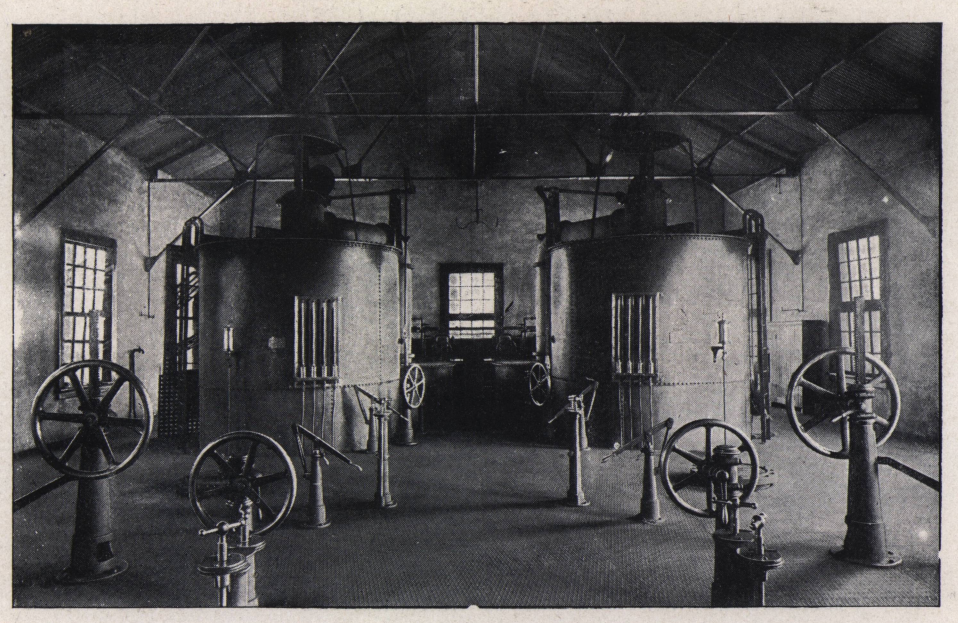

Fig. 14.
Operating Floor of two large Low Carburetter Double Superheater Machines, combined capacity over 2,000,000 cubic feet per diem.

Operating with low heat would be the proper method if the period of contact of the oil vapors with the checker brick of the carburetter and superheater were longer. The means to bring this about immediately suggests itself. *Extend the Checker Brick of Carburetter and Superheater and provide means for properly producing aud controlling heats.* Our Extended Carburetter Superheater design, (Patent No. 790296) presents this and the very excellent results that have been realized in practice with this type assures us that it is the best water gas apparatus on the market, both as to capacity and economy of operation.

Extended Carburetter.

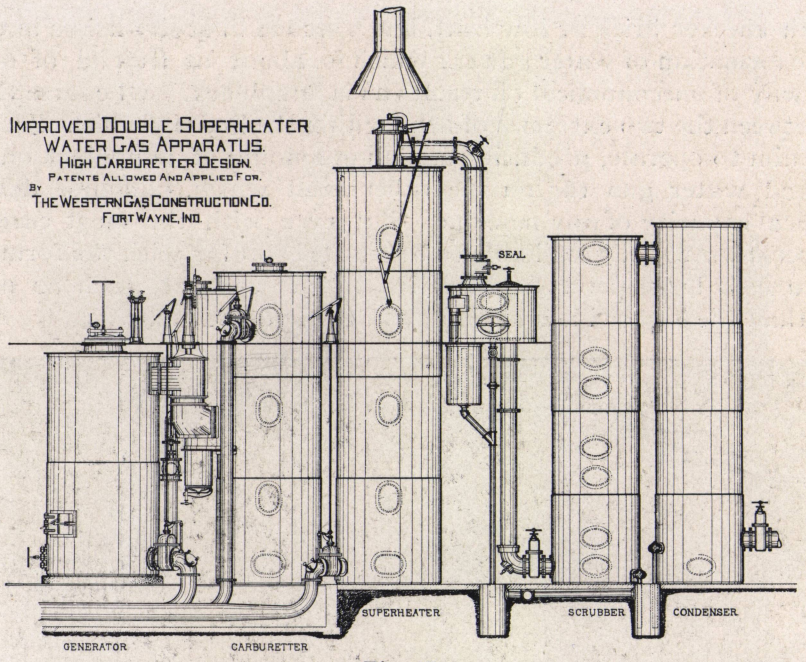

Fig. 15.
Double Superheater Setting—the first form in which the Carburetter extended above the operating floor, with outside Up-take Flue.
For later design with inside Up-take Flue, see Figs. 1, 8, 17 and 18.

We wish here to call attention to several points which must be considered by all gas managers as essential to good water gas making.

Important Features.

1. A *deep* and *uniform* fuel bed in the generator and convenient method of charging.

2. Arresting cinders and ashes from generator in manner for convenient periodical removal.

3. Thorough admixture of the thoroughly atomized and vaporized oils with incoming blue water gas before reaching the heated checker brick.

4. Low heats in checker brick to prevent excessive lamp black.

5. Sufficient checker brick at this lower heat to thoroughly fix all the oil vapors.

6 Seal upon operating floor with adjustable overflow convenient for constant view of the operator.

7. Automatic oil feed system so that a constant pressure of uniformly preheated oil may be maintained at the oil injectors without any special attention of operator.

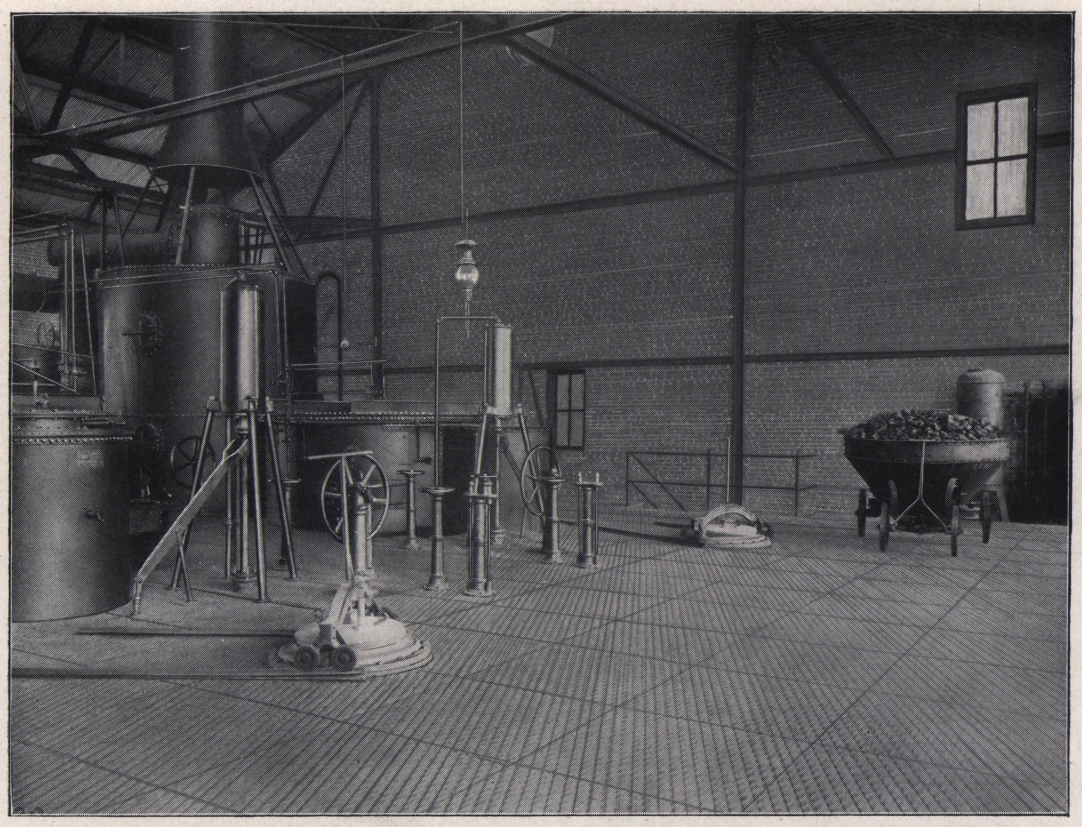

Fig. 16.
Operating Floor of 11′ Extended Carburetter Superheater Apparatus.

In our Extended Carburetter Superheater Apparatus, all these several principal points are provided for by the special features of our machines already noted in reference to our Improved Lowe Water Gas Apparatus, (which features are incorporated in *all* our machines), together with additional important features common only in our extended Carburetter Superheater Apparatus.

Divided Blast.

We wish to call *particular* attention to our *Divided Blast Arrangement* (Patent No. 721695) which is incorporated *only* with our Extended Carburetter Superheater design. With it *uniformity of fire in fuel bed is insured*, permitting the added advantage of keeping the fire close to the grates, with the consequent increased depth of fuel and increased fuel economy.

An even distribution of the air between the grate bars is an ideal condition to possess, minimizing as it does the accompanying blow holes and steam spots, the condition so frequently met with in machines with the direct

blast. With the direct blast the air during the blow seeks its way through the hottest parts of the fuel bed, while the steam during the gas making period passes through the cooler parts where it meets with less resistance; these conditions produce the blow holes and steam spots which in their turn lead to

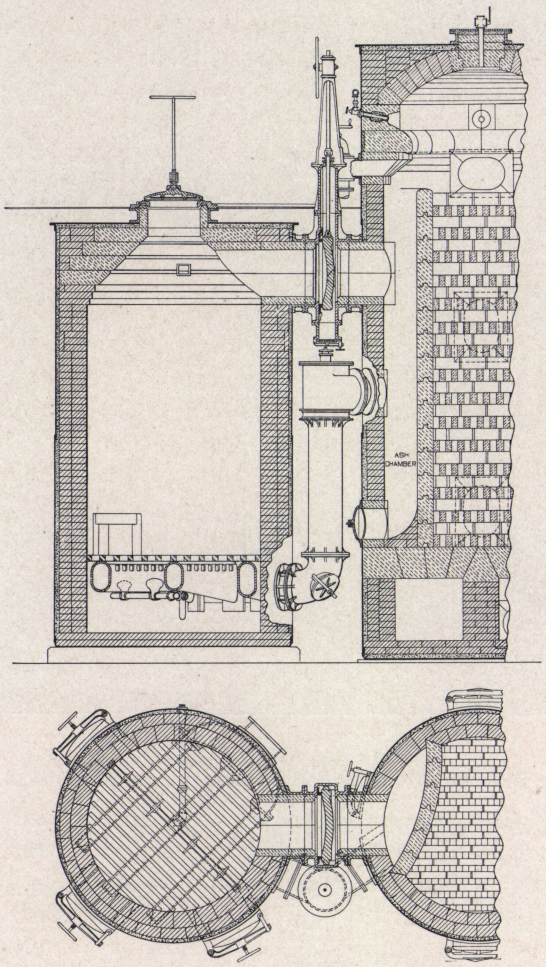
Vaporizing Chamber.
Gate Valve Design.
Carburetter with inside Up-tade Flue and Ash Chamber.
Generator with Divided Blast and Steam Distribution

Fig. 17.

Present Form and Position of Ash Chamber in Up-take Flue, showing Combination Valve Connection (Gate Valve) and Latest Form of Vaporizing Chamber.

the lack of control of the formation of the inert carbon dioxide. Hence more oil is required for enrichment. For uniformity of fuel bed the crowding of the air against the side of the generator opposite the direct blast opening *must* be eliminated. This crowding of the air at these parts is evidenced by the heavy formation of clinkers. The divided blast is the solution, and our arrangement accomplishes it.

Likewise our arrangment insures uniform blast pressure under entire grate, and permits of sharper and shorter blasts. In this connection it is evident that the shorter the blast consistent with a given make of gas, the greater is the capacity of the machine. With the sharper blast (as high as 25 inches water pressure or over) a more complete combustion of the fuel is effected heating to uniform incandescence the entire bed in the shortest length of time.

Increased Capacity.

Sufficient producer gas is warranted, however, to insure the proper heating of the extended checker brick of the carburetter and superheater. On account of the lower heats to be restored in the checker brick, the *sensible* heat of the products of the blow plays a more important part in this recuperation, depending less on the heat liberated by the combustion of the producer gas contained. The extended checker brick is provided for by increasing the height of the carburetter and superheater shells.

The steam supply for the "up runs" in our Extended Carburetter Superheater Apparatus is also divided by our special distributors (patent pending) placed under the grate bars. Thus *uniformity* of the steam supply to the *entire* grate surface is insured. The steam for the "down runs" is distributed over the top of the fuel bed by means of a hollow steel distributor bricked in the lining near the top of the generator. All the steam to the generator as well as to the engine is thoroughly dried and superheated by passing through and entirely around the hollow seat of the large ball valve between the generator and carburetter.

Divided Steam Distribution.

In connection with the divided blast arrangement, the main blast opening in generator is larger than the usual, also the connections between generator and carburetter and between carburetter and superheater are larger; the same is true of the stack tees. This increase in the size of connections materially lessens the power required in blasting up in the reduced time of blow.

Our generator with its divided blast and steam arrangement permits the use of a much poorer grade of fuel than is otherwise possible. It has been demonstrated in practice that a coke containing as high as 40 per cent. breeze can be used with very satisfactory and economical results.

TABLE OF CAPACITIES

—OF—

OUR EARLY APPARATUS.

GIVEN FOR COMPARISON ONLY.

SINGLE SUPERHEATER APPARATUS.

DIAMETER OF SHELLS.		HEIGHT OF OPERATING FLOOR.	APPROXIMATE CAPACITY PER 24 HOURS. CU. FT.
GENERATOR.	CARBURETTER SUPERHEATER		
3 feet 6 inch.	3 feet 0 inch.	9 feet 0 inch.	30,000 to 50,000
4 " 0 "	4 " 0 "	10 " 0 "	75,000 to 100,000
4 " 6 "	4 " 0 "	11 " 0 "	125,000 to 150,000

COMBINED CARBURETTER SUPERHEATER APPARATUS.

4 feet 6 inch.	4 feet 0 inch.	11 feet 0 inch.	125,000 to 150,000
5 " 0 "	4 " 6 "	11 " 6 "	150,000 to 175,000
5 " 0 "	5 " 0 "	12 " 0 "	150,000 to 200,000
6 " 0 "	6 " 0 "	13 " 0 "	225,000 to 275,000
7 " 6 "	7 " 0 "	13 " 6 "	375,000 to 425,000

DOUBLE SUPERHEATER APPARATUS.

DIAMETER OF SHELLS.			HEIGHT OF OFERATING FLOOR	APPROXIMATE CAPACITY IN CU. FT. PER 24 HOURS.
GENERATOR.	CARBURETTER.	SUPERHEATER.		
4 feet 0 inch.	4 feet 0 inch.	4 feet 0 inch.	11 feet 0 inch.	100,000 to 125,000
4 " 6 "	4 " 0 "	4 " 0 "	12 " 0 "	125,000 to 175,000
5 " 0 "	4 " 6 "	4 " 6 "	12 " 6 "	150,000 to 200,000
5 " 6 "	5 " 0 "	5 " 0 "	13 " 0 "	200,000 to 250,000
6 " 6 "	6 " 0 "	6 " 0 "	13 " 0 "	275,000 to 350,000
7 " 6 "	7 " 0 "	7 " 0 "	13 " 6 "	400,000 to 475,000
8 " 6 "	8 " 0 "	8 " 0 "	14 " 0 "	575,000 to 750,000
9 " 6 "	9 " 0 "	9 " 0 "	15 " 0 "	725,000 to 900,000
10 " 6 "	10 " 0 "	10 " 0 "	16 " 0 "	900,000 to 1,100,000
11 " 6 "	11 " 0 "	11 " 0 "	17 " 0 "	1,100,000 to 1,300,000

These tables of capacities, etc., of our early apparatus are taken from one of our former publications on water gas. These capacities were based upon actual results, and at the time of publication, in May, 1897, were considered very satisfactory.

See tables on next page for our Modern Apparatus.

TABLE OF CAPACITIES

—OF—

MODERN APPARATUS.

DOUBLE SUPERHEATER APPARATUS.

DIAMETER OF SHELLS.			† HEIGHT OF OPERATING FLOOR.	CAPACITY PER 24 HOURS CU. FT.
GENERATOR.	CARBURETTER.	SUPERHEATER.		
*3 feet 9 inch.	3 feet 6 inch.	3 feet 6 inch.	11 feet 0 inch.	80,000 to 100,000
4 " 0 "	4 " 0 "	4 " 0 "	12 " 0 "	100,000 to 125,000
4 " 6 "	4 " 0 "	4 " 0 "	12 " 0 "	150,000 to 175,000
*5 " 0 "	4 " 6 "	4 " 6 "	13 " 0 "	200,000 to 225,000
5 " 6 "	5 " 0 "	5 " 0 "	13 " 0 "	225,000 to 275,000
6 " 6 "	6 " 0 "	6 " 0 "	14 " 0 "	350,000 to 450,000
7 " 6 "	7 " 0 "	7 " 0 "	14 " 0 "	475,000 to 676,000
8 " 6 "	8 " 0 "	8 " 0 "	15 " 0 "	800,000 to 950,000
9 " 6 "	9 " 0 "	9 " 0 "	15 " 0 "	1,000,000 to 1,300,000
10 " 6 "	10 " 0 "	10 " 0 "	16 " 0 "	1,275,000 to 1,600,000
*11 " 0 "	10 " 6 "	10 " 6 "	16 " 0 "	1,500,000 to 1,850,000
11 " 6 "	11 " 0 "	11 " 0 "	17 " 0 "	1,650,000 to 2,000,000

EXTENDED CARBURETTER SUPERHEATER APPARATUS.

6 feet 6 inch.	6 feet 6 inch.	6 feet 0 inch.	14 feet 6 inch.	430,000 to 500,000
7 " 6 "	7 " 6 "	7 " 0 "	14 " 6 "	700,000 to 800,000
8 " 6 "	8 " 6 "	8 " 0 "	15 " 6 "	950,000 to 1,100,000
9 " 6 "	9 " 6 "	9 " 0 "	15 " 6 "	1,250,000 to 1,400,000
*10 " 6 "	10 " 6 "	10 " 0 "	16 " 6 "	1,600,000 to 1,900,000
11 " 0 "	11 " 0 "	10 " 6 "	17 " 0 "	1,950,000 to 2,300,000
13 " 0 "	12 " 6 "	12 " 0 "	21 " 0 "	2,850,000 to 3,300,000

* Special sizes.

See also Bulletin 210A for small apparatus.

In compiling the table of our Modern Apparatus, the capacities are based upon *actual results*, but the capacity of any apparatus is of course dependent upon the skill and care of the operator, kind of fuel and oil used as well as the quality of steam supply and gas required. It is proper in this connection to state in comparing these capacities with those of machines of other concerns, that the shells of all our modern apparatus are fitted with very heavy double lining proportionately reducing internal diameter, aud grate and checker brick areas.

† Heights of operating floors as given here are approximate for coke, permitting a fuel bed of 7 feet in our smallest generators, and proportionately deeper fuel bed in larger sizes; the liberal heights of our generators permits modification to suit existing apparatus or combination installations of different sizes of apparatus.

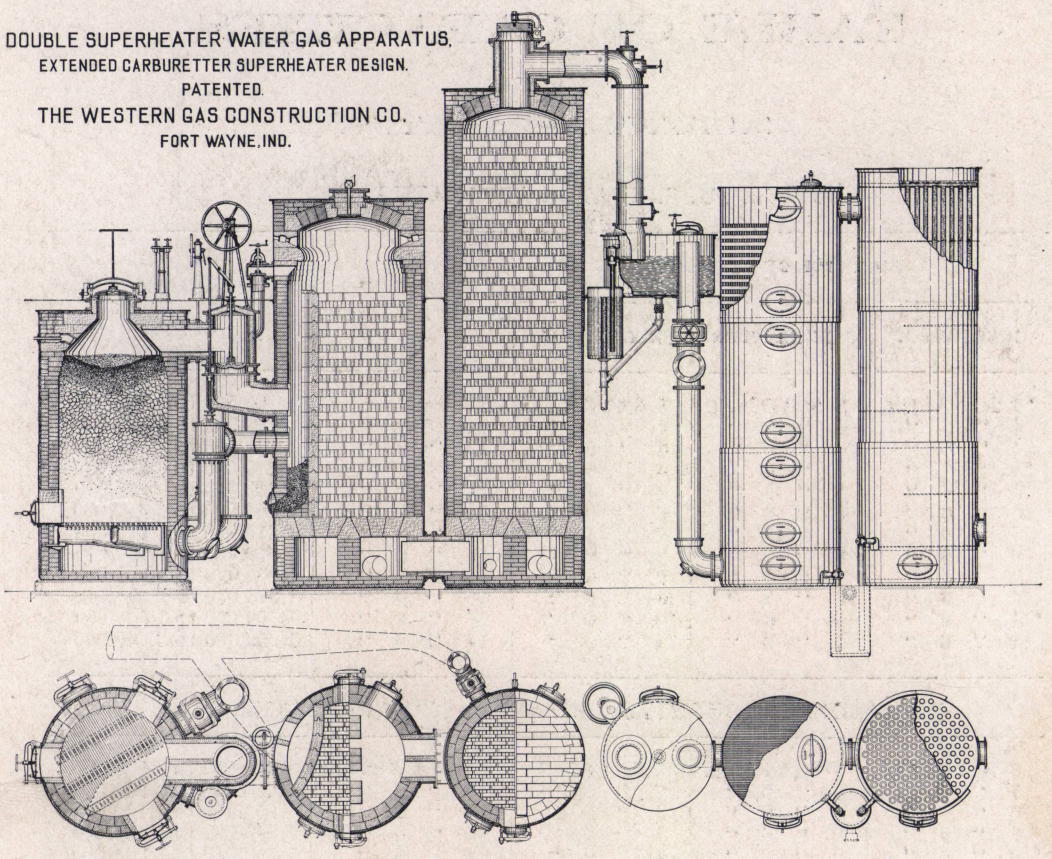

Fig. 18.
Plan and Elevation of a 7′ 6″ Modern Extended Carburetter Superheater Set. Reversed steam connection operated by rack and pinion. We are prepared to supply rack and pinion or hydraulic lift for operating blast, reversed steam, and stack valves.

Our policy ever *has* been and still is, that of improvement. We realize that the Standard in Water Gas Construction, as in all other branches of construction, is continually changing.

We *know* from *practical results* and from the opinions of *practical men*, that we have superior apparatus and we are constantly striving to make it better. We are prepared, however, to build any special design of apparatus that may be desired to meet conditions presented, and in accordance with designs prepared by, or submitted to us.

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